

**Baseline Survey for  
*Astragalus barrii* Barneby (Barr's Milkvetch)  
and *Physaria didymocarpa* var. *lanata*  
A. Nels (Woolly Twinpod) in Eastern  
Big Horn and Southwestern Rosebud  
Counties, Montana**

Prepared for:

The Bureau of Land Management

Prepared by:

Amy Taylor and Richard Caners

Montana Natural Heritage Program  
Natural Resource Information System  
Montana State Library

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# **Baseline Survey for *Astragalus barrii* Barneby (Barrís Milkvetch) and *Physaria didymocarpa* var. *lanata* A. Nels (Woolly Twinpod) in Eastern Big Horn and Southwestern Rosebud Counties, Montana**

Prepared for :  
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## Executive Summary

In 2001, The Bureau of Land Management (BLM) Miles City Field Office contracted with the Montana Natural Heritage Program (MTNHP) to conduct baseline surveys for two species of Special Concern, *Astragalus barrii* Barneby (Barr's milkvetch) and *Physaria didymocarpa* var. *lanata* A. Nels. (woolly twinpod), in eastern Big Horn County and southwestern Rosebud County. Both of these species are regional endemics, their overall range being restricted to portions of adjacent Montana, Wyoming and South Dakota.

Both species are known to occur within the study area, but had not been systematically inventoried. Prior to this survey, *P. didymocarpa* var. *lanata* was known in Montana from only one location in Big Horn County, and had been documented from 14 occurrences in north-central Wyoming. *A. barrii* had previously been documented from 33 locations in southeastern Montana, and was known from South Dakota and Wyoming.

Surveys from this study resulted in four new occurrences of *P. didymocarpa* var. *lanata* and one new occurrence of *A. barrii* in the study area. Habitat information including associated plant species, and topographic and edaphic conditions was collected. This information provides additional baseline information for both species in Montana, and serves as a basis for BLM evaluation of the potential impacts of coal bed methane development on these plants and their habitats. The information found in this report may also help clarify the BLM status of these species, and will assist BLM staff with future field identification of both species and their respective habitats.

## Introduction

In 2001, The Bureau of Land Management (BLM) Miles City Field Office contracted with the Montana Natural Heritage Program (MTNHP) to conduct baseline surveys for two species of Special Concern, *Astragalus barrii* Barneby (Barr's milkvetch) and *Physaria didymocarpa* var. *lanata* A. Nels. (woolly twinpod), in eastern Big Horn County and southwestern Rosebud County. Both of these species are regional endemics, their overall range being restricted to portions of adjacent Montana, Wyoming and South Dakota. *A. barrii* is presently ranked at the global and state levels as G3 S3, suggesting the plant is vulnerable because of rarity or restricted range, even though it may be abundant at some of its locations (Heidel 2001). *P. didymocarpa* var. *lanata* is presently ranked as G5T2 S1, suggesting the plant is critically imperiled at the state level because of extreme rarity and/or other factors making it highly vulnerable to extinction (Heidel 2001).

The purpose of this study was to identify additional areas of occurrence or potential occurrence, and in the process develop a better understanding of the habitat characteristics of these species. Surveys were focused on BLM lands in eastern Big Horn and Rosebud Counties to provide additional information on species' distribution and habitat requirements, to document factors that have the potential to affect the long-term viability of the species in the area, and to provide management recommendations for the species based on new and existing information.

Both *A. barrii* and *P. didymocarpa* var. *lanata* are known to occur within the study area, but had not been systematically inventoried. Prior to this survey, *P. didymocarpa* var. *lanata* was known in Montana from only one location in Big Horn County. This species is also documented from 14 occurrences in north-central Wyoming. *A. barrii* is also known from South Dakota and Wyoming, and had previously been documented from 33 locations in southeastern Montana. This species is maintained as a Watch species on the BLM Montana State Plant List (BLM 1996).

Pertinent biological information for both species is outlined in **Appendix 1**. This information provides a more in-depth understanding of the species' habitat and conservation needs.

## Study Area

The study area is defined as eastern Big Horn County and southwestern Rosebud County, Montana, bounded by the Crow Reservation (west), Cheyenne Reservation (north), Custer National Forest (east) and Wyoming border (south) (see **Figures 1 and 2**, study area extent). The Tongue River and its drainages characterize the central portion of the study area. Geologically, examples of the Tertiary Fort Union Formation are found throughout the area. The formation consists of alternating layers of shale, clay siltstone and sandstone, and contains many clinker (also known as red scoria: baked sandstone and shale) and coal beds. The upper part of the Fort Union Formation is the Tongue River Member, which is the most productive coal-bearing geologic section in Montana (Soil Survey 1996).

Tracts of land managed by the BLM or the State of Montana are interspersed among large areas of private land, with livestock grazing as the dominant agricultural industry. Coal mining operations are currently localized in the southwestern part of Big Horn County within the survey area.

Ponderosa pine woodland, grassland, sagebrush steppe and barren calcareous substrate are found throughout the study area. The habitat of *A. barrii* is characterized by a very sparse cover of *Pinus ponderosa* (ponderosa pine) or *Juniperus scopulorum* (Rocky Mountain juniper) at some locations, but often only a sparse shrub cover of *Artemisia tridentata* (big sagebrush) and/or *Atriplex confertifolia* (shadscale) is present. Vegetative cover of grasses and forbs at these sites is low, with few dominant species (Heidel & Marriott 1996). In southeastern Montana, the dominant plant species associated with *A. barrii* include *Pascopyrum smithii* and *Elymus lanceolatus* (western and thickspike wheatgrass, respectively), *Stipa viridula* (green needlegrass), *Andropogon scoparius* (little bluestem), *Agropyron spicatum* (bluebunch wheatgrass), *Koeleria macrantha* (prairie junegrass), native legumes, *Artemisia tridentata* (big sagebrush), *Atriplex gardneri* (Nuttall saltbush) and *Krascheninnikovia lanata* (winterfat) (Heidel & Marriott 1996).

Much less information is available on the habitat and species associated with *P. didymocarpa* var. *lanata*, although occurrence records for the species in the Heritage database suggest that habitat characteristics and species associations are somewhat similar to that of *A. barrii*. Commonly associated species include *Pinus ponderosa*, *Juniperus scopulorum*, *Rhus trilobata* (fragrant sumac), *Artemisia* spp., and the graminoids *Agropyron spicatum* and *Stipa comata* (needle-and-thread grass).

## Methods

Prior to beginning fieldwork, we identified potential habitat for *Astragalus barrii* and *Physaria didymocarpa* var. *lanata* using USGS topographic maps, soil data (Soil Survey 1996) and information collated from the MTNHP database. Although an optimal start date for field work would have been in late May – early June, corresponding with the flowering times of both species, the earliest start time for this project had to be scheduled for mid-June. To verify that *A. barrii* and *P. didymocarpa* var. *lanata* plants had the reproductive or vegetative structures needed for positive identification, we initially surveyed some known locations for each species. Populations of both species were visited near Spring Creek Mine on June 18, 2001. Specimens of *P. didymocarpa* var. *lanata* had mature fruit. The most diagnostic characteristic for this taxon is the long, tangled spreading hairs on the leaves. Although leaf pubescence is sufficient for identification (Fertig 2000), fruit characters contribute to the positive identification of the species. Flowers or their remnants are necessary to positively identify *A. barrii* from other area *Astragalus* species that have compound leaves with three leaflets and cushion-forming habit (Heidel & Marriott 1996). The timing of the surveys fell at the end of *A. barrii*'s blooming period and after an unusually dry May. Therefore, visits to known locations were warranted to determine phenology. Individuals of this species found at the Spring Creek location had faded remnant flowers and mature fruit. A suite of characters including petal size, calyx size, peduncle length and leaflet morphology were sufficient to identify the plants as *A. barrii*.

Surveys were expanded to areas of potential habitat once we confirmed that diagnostic characteristics could still be observed in the field.

We contracted with Amy Taylor, a consulting botanist who has field experience identifying *A. barrii* in nearby portions of Wyoming, to conduct field surveys between June 18-27, 2001. Priority was given to potential habitats on the largest tracts of BLM-administered lands in the study area. Surveys were also conducted on state lands and, where permission was granted, on private lands.

For each species, we developed a search profile for potential habitat, based on existing habitat information:

*A. barrii*: Ridgetops, buttes, outcrops, badlands and slopes with sandy clay loam soils or calcareous substrates; vegetation associations of sagebrush-grassland, ponderosa pine and Rocky Mountain juniper, or cushion communities; typically sparsely vegetated areas.

*P. didymocarpa* var. *lanata*: Slopes and road cuts with red scoria (clinker) and clay-shale substrates; also calcareous substrates and gravelly unstable slopes; emphasis on south-facing slopes; sparsely vegetated areas in sagebrush-grassland, mixed-shrub, and ponderosa pine communities; near 3800 f.a.s.l. and above.

For each population of *A. barrii* or *P. didymocarpa* var. *lanata* that was visited in the field, we completed an MTNHP Plant Species of Concern Survey form, including documentation of Ecological Rangeland Sites (Natural Resources Conservation Service 2000). Global Positioning System coordinates were taken for new locations of the target species. Where appropriate, slide and print photographs were taken and subsequently entered into the MTNHP's Slide Image Database (SID). Voucher specimens were collected and verified at the Rocky Mountain Herbarium in Laramie, Wyoming. Landowner permissions were also documented.

## Results

All new and existing occurrences of *Astragalus barrii* and *Physaria didymocarpa* var. *lanata* in the study area are mapped in **Figures 1 and 2**, respectively, and described in **Tables 1 and 2**, respectively. Occurrence numbers associated with specimens in Figures 1 and 2 correspond with occurrence numbers in Tables 1 and 2, and are the numbers assigned to the occurrences in the Heritage database. No other Species of Concern were encountered during the survey. Search routes for both species are indicated on the 1:24,000 USGS Quad maps found in **Appendix 2**. The search routes define both areas of potential habitat that were identified and surveyed (solid black lines), as well as potential habitat that was identified in the field but not surveyed (solid red lines). Selected photographs from the project are included in **Appendix 3**.

Population sizes of *A. barrii* in the study area vary widely, ranging from less than 10 to thousands of individuals (see Table 1). The one new population documented in the study area consists of 4 major clusters of individuals approximately 12 cm wide. Population sizes of *P. didymocarpa* var. *lanata* in the study area (including the 4 new occurrences) range in size from 16 to thousands of individuals (Table 2).

The habitat information for the one new occurrence of *A. barrii* in the study area is consistent with other records in the study area for the species (see Table 2). The species typically occurs on red shale and sandstone outcrops with the associated species *Juniperus scopulorum* (Rocky Mountain juniper), *Pinus ponderosa* (ponderosa pine), *Agropyron spicatum* (bluebunch wheatgrass) and *Artemisia tridentata* (big sagebrush).

Habitat information for *P. didymocarpa* var. *lanata* in the study area has been greatly improved upon with the discovery of four new occurrences. Habitat summaries are provided in Table 2. Generally, the species occurs on steep, south- to southwest-facing slopes of sandstone outcrops and red shale, with the associated species *Pinus ponderosa*, *Juniperus scopulorum*, *Agropyron spicatum* and *Rhus trilobata* (fragrant sumac). The habitat characteristics and associated species of *P. didymocarpa* var. *lanata* appear to be relatively similar to that of *A. barrii*.

New occurrence records for *A. barrii* and *P. didymocarpa* var. *lanata* were found along 5 of the approximately 17 search routes (delineated with solid black lines; Appendix 2). Potential unsurveyed habitat for both species has been illustrated with solid red lines. This habitat has the potential to support new populations of both species and should be more carefully examined.

### Ecological Site Associations

Both species occur in the Major Land Resource Area 58AE, the Eastern Sedimentary Plains (USDA 2000). The one new occurrence of *A. barrii* was found on the Badlands (BL) Rangeland Ecological Site, while the four new occurrences of *P. didymocarpa* var. *lanata* were found on Coarse Clay (CC), Badlands (BL) and Thin Breaks (TB) Rangeland Ecological Sites. Badlands (BL) and Thin Breaks (TB) Rangeland Ecological Sites belong to Group 4 of the Montana Key for Ecological Sites (USDA 2000), keying out as sites that are treated as complexes. Coarse Clay (CC) Rangeland Ecological Sites belong to Group 2, keying out as sites that are affected by reduced moisture, generally due to a lack of soil depth, salts or slope (USDA 2000).

Thin Breaks (TB) Rangeland Ecological Sites are characterized by a landscape that has steep to very steep, angular and rough topography, with the tops of these sites appearing somewhat level. Outcrops of sandstone, silt-stone or other hard rock dominate parts of the site. There are numerous ledges where an occasional tree occurs. The majority of vegetation is generally typical of sandy or silty sites, but with more shrubs (USDA 2000).

Badlands (BL) Rangeland Ecological Sites are characterized by landscapes which are more rounded, with the tops of hills and knobs appearing more rounded, and have outcrops of shales as a dominant part of the landscape. There is often evidence of salts, often occurring around the base of hills and knobs. Very few trees occupy this site, with an occasional *Juniperus scopulorum*. Vegetation is sparse. The species present are often typical of clayey sites, but with a greater abundance of shrubs (USDA 2000).

Coarse Clay (CC) Rangeland Ecological Sites occur on undulating to rolling uplands, fans, foot slopes and low ridges. A coarse clay site is normally located on unstable landscapes of slumping shales, commonly with hummocky or dune-like topography. These sites have soils with less than 10 inches to hard bedrock (USDA 2000).

## Discussion

This survey generated valuable new information on the habitat requirements and geographic distribution of *Astragalus barrii* and *Physaria didymocarpa* var. *lanata* in eastern Big Horn and southwestern Rosebud Counties. Prior to the surveys, *P. didymocarpa* var. *lanata* was known in Montana from only one location in Big Horn County. Occurrences are now documented from one more location in Big Horn County and three locations in Rosebud County. One new small population of *A. barrii* was observed and documented in Rosebud County.

Few studies have addressed the direct impacts and threats affecting the long-term viability of the species. Heidel & Marriott (1996) indicate that *A. barrii* is found on secondary range, and is characterized by a low, tufted growth form and early-season flowering. The species is therefore minimally affected by grazing management, unless livestock developments are placed near populations or grazing fosters weed encroachment or major shifts in plant community development that otherwise increase competition. Both *Melilotus officinalis* (yellow sweetclover) and the native species *Triodanis perfoliata* (Venus looking glass) have been observed to dominate some areas, apparently corresponding with heavy grazing in directly adjoining habitat. The same authors also suggest that the species may be affected by herbicide spraying and early-season pesticide spraying (Heidel & Marriott 1996).

Coal bed methane development has the potential to alter and degrade habitat of *A. barrii* and *P. didymocarpa* var. *lanata* (Schassberger 1990; Heidel & Marriott 1996; Taylor pers. obs.). Known locations of both species exist near coal mines or in areas of proposed development. Shale, clay siltstone, sandstone and red clinker characterize much of the study area and support habitat where both species are known to occur. Grazing, quarrying and exotic species are potential low-level threats that may also exist (Schassberger 1990; Heidel & Marriott 1996). Large-scale modification of habitat as a result of extensive physical removal and damage are activities that have the potential to negatively affect the long-term viability of both species.

Recommendations for maintaining viable populations of *A. barrii* and *P. didymocarpa* var. *lanata* include (adapted from Heidel and Marriott 1996):

### *A. Protection of natural habitats on BLM administered lands that currently support populations*

Protection may be achieved by recognizing the sites with stable populations as special management areas. The Zook Creek populations of *P. didymocarpa* var. *lanata* may receive protection since they lie within a BLM Wilderness Study Area. Management priority should be given to both species, with consideration being given to *P. didymocarpa* var. *lanata* as an addition to the BLM's Sensitive or Watch list.

Heidel and Marriott (1996) recommend the protection of natural habitats that support large populations of *A. barrii*, as larger populations appear to be buffered against drought conditions.

### *B. Regulation of activities directly adjoining native habitats that support populations*

Thorough population surveys and assessments should be conducted prior to proposed disturbances within or near any documented populations of *A. barrii* and *P. didymocarpa* var. *lanata* and their potential habitats. These species should be addressed in management decisions regarding grazing allotments, weed management plans, oil and gas leases, mining permits and similarly-related activities.

### Recommendations for further assessment

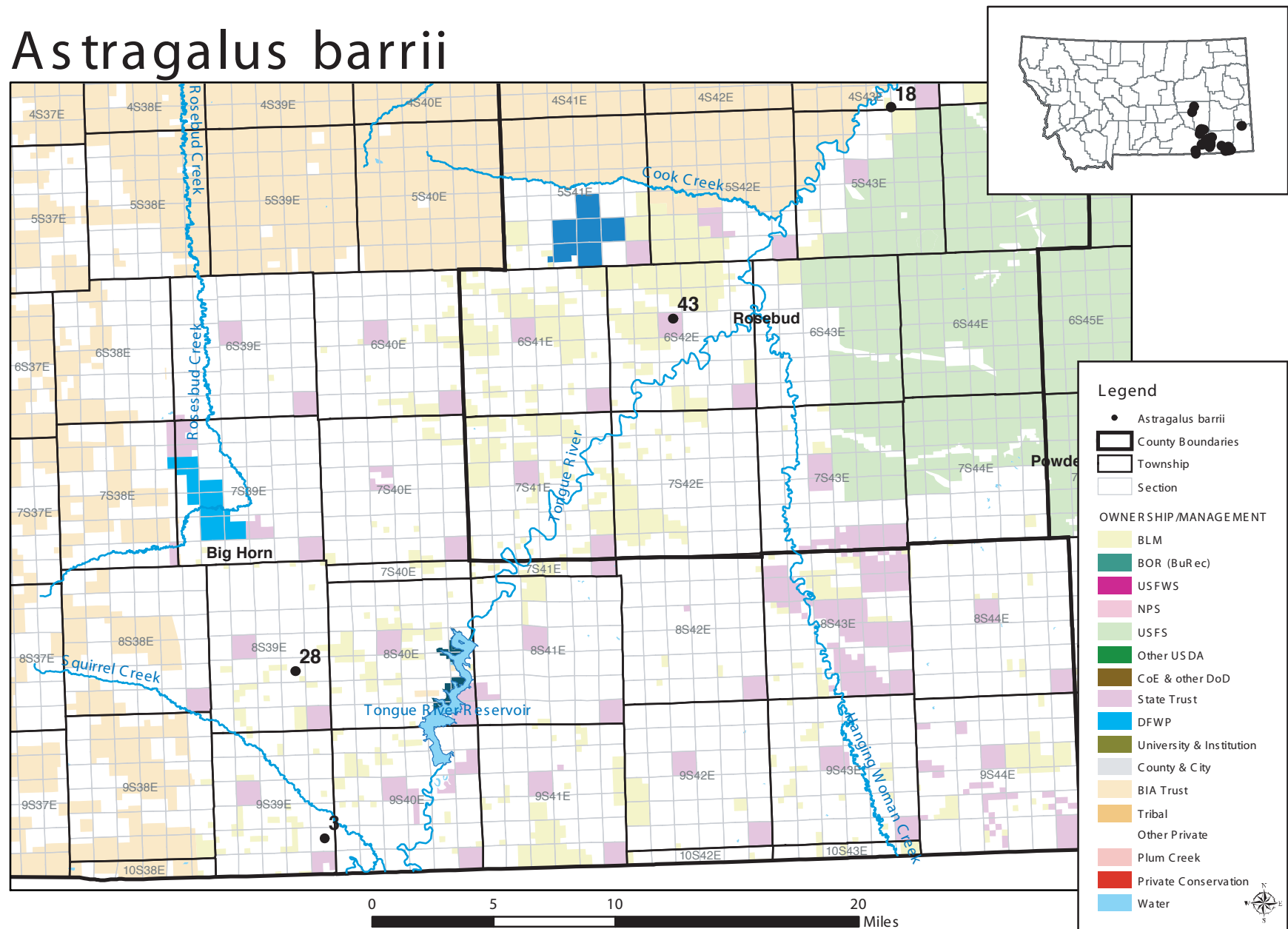
Due to the prevalence of potential habitat for *A. barrii* and *P. didymocarpa* var. *lanata* in the study area, there is a high likelihood that additional populations remain undiscovered (Schassberger 1990; Taylor pers. obs.). Some areas, identified as potential habitat, were not surveyed due to time constraints or access limitations (see **Appendix 2**). BLM-Miles City Field Office staff who conduct fieldwork within the study area are encouraged to become familiar with field recognition of *A. barrii* and *P. didymocarpa* var. *lanata*, as well as their habitats and closely-related species. The new occurrence of *A. barrii* near Whitten Creek is comprised of just a few individuals. Further searches within the State section and adjacent BLM sections are warranted in order to obtain a more accurate population size. *A. barrii* should be surveyed from early to mid-May when it is typically in full bloom. Dried remnant flowers often lose their color making the species more difficult to confidently identify.



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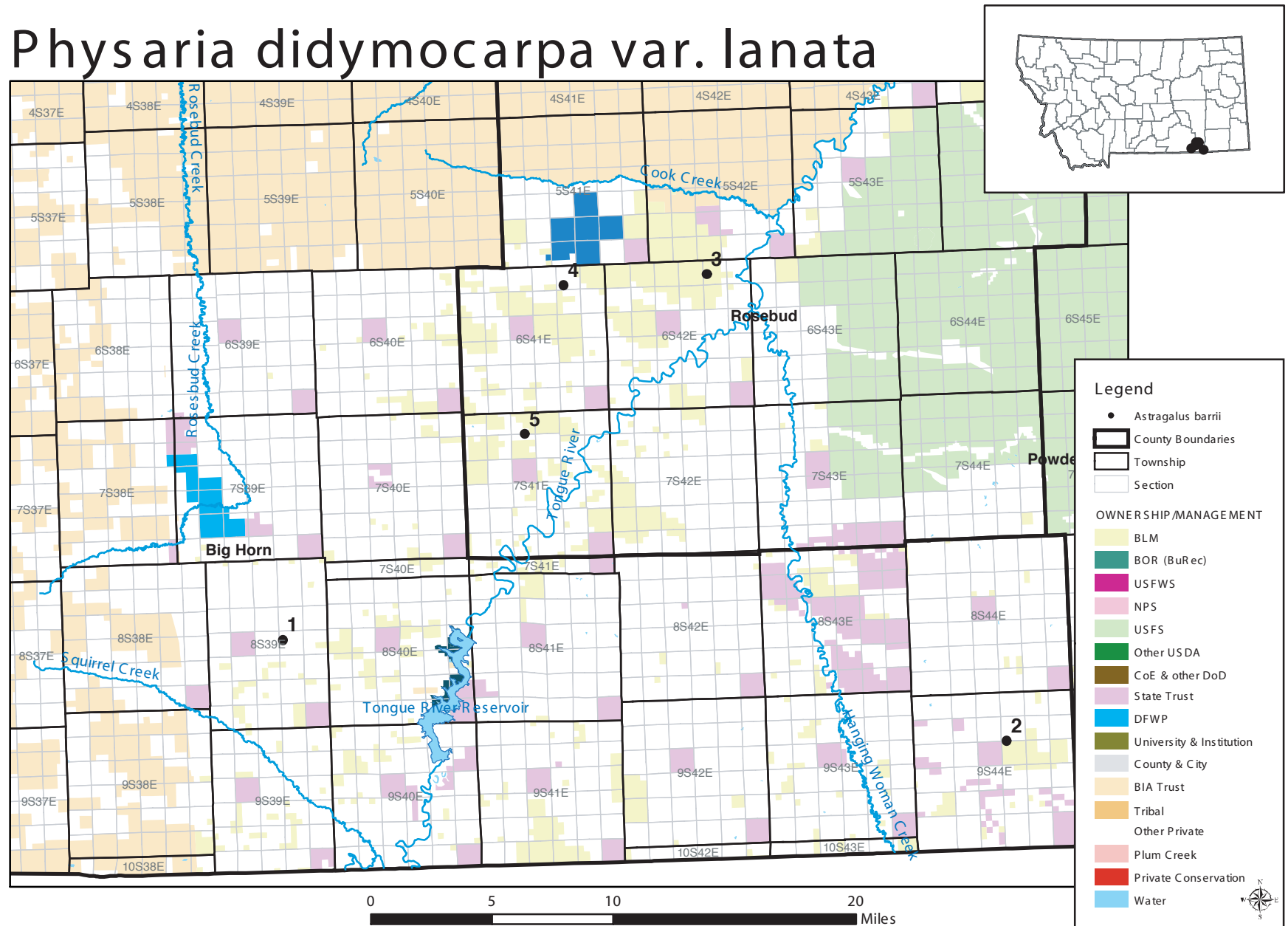
# Astragalus barrii



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**Figure 1.** The four occurrence records for *Astragalus barrii* in the study area. There are two occurrences in eastern Big Horn County, and 12 occurrences (including one new occurrence from this study, 043) in southwestern Rosebud County. All 34 occurrences of the species in state of Montana are illustrated in the upper right hand corner of the figure.

# Physaria didymocarpa var. lanata



**Figure 2.** The five occurrence records for *Physaria didymocarpa* var. *lanata* in the study area. There are two occurrences in eastern Big Horn County (including one new occurrence, 002), and 3 occurrences (all new, 003-005) in southwestern Rosebud County. All 5 occurrences of the species in state of Montana are illustrated in the upper right hand corner of the figure.

**Table 1.** All Element Occurrence (EO) records for *Astragalus barrii* Barneby in the project study area (Big Horn and Rosebud counties). Selected descriptive fields are presented for each EO, taken directly from the Heritage database, with new occurrences for this study highlighted in bold text.

EO Number	County	Survey Site	Element Occurrence Data	General Description	Major Land Resource Area	Rangeland Ecological Site	Latitude	Longitude	Township and Range	Section	TRS Note
003	Big Horn	Decker	Common.	Barren clay soil on ridgetop, with <i>Haplopappus acaulis</i> and <i>Eriogonum pauciflorum</i> .	-	-	450102N	1065349W	009S039E	25	NE4
004	Rosebud	Colstrip Southeast	Unknown.	Steep butte with many roadcuts and grazing marks; on border of watershed 10100003.	-	-	455137N	1063540W	001N041E	11	NE4
005	Rosebud	Miller Coulee	Just over fence from 'Area A'. Reclamation (Big Sky Strip Mine).	On barren, decomposing sandstone cap; in sparse vegetation surrounded by <i>Pinus ponderosa</i> , with <i>Humenopappus filifolius</i> , others.	-	-	454923N	1063728W	001N041E	22	NW4SW4
015	Rosebud	King Creek Well	Approx. 2,000 plants, flowering prolifically. Active pollination observed.	Eroding hillside of silty-clay soil, with <i>Artemisia tridentata</i> , <i>Atriplex confertifolia</i> , <i>Yucca glauca</i> , <i>Comandra umbellata</i> .	-	-	452847N	1061716W	004S044E	22	NW4
018	Rosebud	Gate Creek	Approx. 200-250- plants, flowering. Evidence of livestock grazing.	Eroding knoll; with <i>Artemisia tridentata</i> , <i>Atriplex confertifolia</i> and <i>Andropogon scoparius</i> .	-	-	452624N	1062353W	004S043E	34	SE4; 35 SW4
019	Rosebud	O'Dell Creek Butress	Approx. 200 plants scattered atop cliff and below; 25% flowering.	In silty-clay soils, with <i>Artemisia tridentata</i> , <i>Festuca idahoensis</i> , and <i>Gutierrezia sarothrae</i> .	-	-	452735N	1062044W	004S044E	30	
027	Rosebud	Colstrip Southeast	None.	On sandstone hillslope (Entisol), with <i>Pinus ponderosa</i> , <i>Andropogon scoparius</i> , <i>Oryzopsis hymenoides</i> and <i>Bromus tectorum</i> .	-	-	455111N	1063506W	001N041E	12	NW4SW4
028	Big Horn	Spring Creek	This occurrence contains 7 subpopulations spread over an area roughly 4 miles E-W by 1.5 miles N-S. Each subpopulation has from 20 to 1000 plants.	On fine, sandy-clay loam soil, above a sandstone outcrop, and bare, dry fine soil or shale, with <i>Artemisia tridentata</i> , <i>Agropyron spicatum</i> , <i>Phlox hoodii</i> , <i>Astragalus gilviflorus</i> , <i>Oxytropis sericea</i> , and <i>Eriogonum</i> spp.	-	-	450702N	1065501W	008S039E	23	NW4SE4; 15 SW4; 16 SE4; 22 NE4; 13 N2; 14 NE4.
030	Rosebud	Stellar Creek Road	3 small areas with approx. 30 plants total. Several plants flowering.	Sparse vegetation (80% bareground) on rocky, windblown outcrops, with <i>Artemisia tridentata</i> , <i>Agropyron spicatum</i> , <i>Eriogonum pauciflorum</i> , <i>Lesquerella alpina</i> .	-	-	464043N	1065417W	011N038E	26	
035	Rosebud	Rosebud Creek	Over 50 plants, 10% in late flowering, 90% vegetative. Scattered on 3 slope segments.	Shale outcrop ridgetops dominated by <i>Agropyron spicatum</i> , overlying sandstone, on small escarpments in rolling plains, associated species: <i>Pinus ponderosa</i> , <i>Rhus trilobata</i> , <i>Artemisia longifolia</i> , <i>Astragalus gilviflorus</i> .	-	-	455022N	1062737W	001N042E	13	W2
038	Rosebud	Davidson Coulee	6 plants in 2 sub-populations, in vegetative condition.	Midslope outcrops on sandstone and overlying shale on north aspect of east-west trending ridges above Rosebud Creek. In <i>Pinus ponderosa</i> / <i>Agropyron spicatum</i> habitat type. Associated species: <i>Juniperus scopulorum</i> , <i>Astragalus gilviflorus</i> , <i>Carex filifolia</i> .	-	-	454207N	1064009W	002S041E	4	NE4
040	Rosebud	Big Porcupine Creek	None provided.	Prominent escarpment above the southwest side of Porcupine Creek, on a midslope finger ridge dominated by <i>Agropyron spicatum</i> .	-	-	462824N	1070111W	008N038E	6	SE4SW4
041	Rosebud	Bridge Creek	Seven subpopulations with 50-200 individuals, at least 700 individuals in all. None in flower or fruit (1 peduncle seen).	Sparsely vegetated slopes. Associated plant community: <i>Eriogonum pauciflorum</i> , <i>Agropyron spicatum</i> , <i>Agropyron dasystachyum</i> , <i>Artemisia tridentata</i> , <i>Gutierrezia sarothrae</i> . Associated plants: <i>Grindellia squarrosa</i> , <i>Astragalus giviflorus</i> , <i>Machaeranthera grindeloides</i> , <i>Eriogonum flavum</i> .	-	-	453122N	1061516W	004S044E;	02;	NE4NE4; SW4; NW4
<b>043</b>	<b>Rosebud</b>	<b>Whitten Creek</b>	<b>4 major mats/clumps (approx. 12 cm wide) on knob. Fruiting with some remnant flowers.</b>	<b>Ponderosa pine - Rocky Mountain juniper; hills of red shale and sandstone, and badlands. NW-facing knob of badlands, very sparsely vegetated. An occasional greasewood shrub, juniper or ponderosa pine; bluebunch wheatgrass present. Associated species include <i>Sarcobatus vermiculatus</i>, <i>Pinus ponderosa</i>, <i>Juniperus scopulorum</i>, <i>Cryptantha</i> sp., <i>Agropyron spicatum</i>; <i>Astragalus gilviflorus</i> common on same hills.</b>	<b>Eastern Sedimentary Plains, 58AE</b>	<b>Badlands (BL)</b>	<b>451908N</b>	<b>1063519W</b>	<b>006S042E</b>	<b>16</b>	<b>NE4</b>

**Bolded** records indicate new occurrences documented during this survey.

**Table 2.** All Element Occurrence (EO) records for *Physaria didymocarpa* var. *lanata* A. Nels. in the project study area (Big Horn and Rosebud counties). Selected descriptive fields are presented for each EO, taken directly from the Heritage database, with new occurrences for this study highlighted in bold text.

EO Number	County	Survey Site	Element Occurrence Data	General Description	Major Land Resource Area	Rangeland Ecological Site	Latitude	Longitude	Township and Range	Section	TRS Note
001	Big Horn	Spring Creek	2001: locally abundant; 90% flowering, 10% basal rosette only. Size of occupied area is similar to 1993 estimate. 1993: flowering mostly in May, but a few plants still flowering in August. Locally abundant, 1000-2000 plants.	1993: "scoria" and sometimes shale substrate. 2001: steep southwest-facing slope of red scoria and shale substrate; hills rise from Spring Creek bottomland. Characteristic associated species include <i>Stipa comata</i> , <i>Agropyron spicatum</i> , <i>Oryzopsis hymenoides</i> , <i>Phlox hoodii</i> . Other common species include: <i>Chaenactis douglasii</i> , <i>Sphaeralcea coccinea</i> .	-	-	450804N	1065533W	008S039E	14	N2; 22 E2
002	Big Horn	Tidwell Draw	Over 100 individuals covering entire south-facing exposure; 95% fruiting; <5% vegetative. 5 or 6 large individuals (>20 cm wide with fruits).	Steep, sandy, south-facing slope above draw with sandstone outcrops and fragments; fairly productive slope - high grass cover. Shrubs and grass community with an occasional <i>Juniperus scopulorum</i> or <i>Pinus ponderosa</i> . Grasses dominate: <i>Stipa comata</i> , <i>Agropyron spicatum</i> , <i>Bromus japonicus</i> . Shrubs: <i>Rhus trilobata</i> , <i>Artemisia tridentata</i> , <i>Ceratoides lanata</i> , <i>Astragalus gilviflorus</i> , <i>Yucca glauca</i> , <i>Opuntia polyacantha</i> .	Eastern Sedimentary Plains, 58AE	Thin Breaks (TB)	450330N	1061909W	009S044E	15	NW4; 10 SE4SW4
003	Rosebud	Zook Creek	Approximately 50 individuals; 20% fruiting, 80% vegetative (basal rosettes only). Doesn't occur in areas of slope that are significantly composed of red shale.	Southwest-facing slope of redbed shale and sand east of creek. Red shale and sand slope below sandstone outcrop. Moderately steep slope. Open slope of <i>Pinus ponderosa</i> and <i>Juniperus scopulorum</i> ; bunch grasses and shrubs also common. Associated species include <i>Pinus ponderosa</i> , <i>Juniperus scopulorum</i> ; shrubs: <i>Yucca glauca</i> , <i>Rhus trilobata</i> , <i>Atriplex confertifolia</i> ; grasses: <i>Agropyron spicatum</i> , <i>Stipa comata</i> , <i>Bouteloua curtipendula</i> ; Forbs: <i>Gaura coccinea</i> , <i>Sphaeralcea coccinea</i> , <i>Psoralea</i> sp.	Eastern Sedimentary Plains, 58AE	Coarse Clay (CC)	452032N	1063325W	006S042E	2	NW4SW4; 3 NE4NW4
004	Rosebud	Bull Creek	Fairly abundant; 16 individuals in one area, occupying approx. 20 square feet.	Sandy, rocky, southwest-facing slope of roadcut, clinker-shale mix, sparsely vegetated. Southwest-facing slope adjacent to 2-track road. Loose, sandy shale. Dominated by grasses; interspersed with <i>Rhus trilobata</i> and <i>Artemisia cana</i> . Associated species include <i>Agropyron spicatum</i> , <i>Artemisia cana</i> , <i>Artemisia frigida</i> , <i>Rhus trilobata</i> , and <i>Eriogonum</i>	Eastern Sedimentary Plains, 58AE	Coarse Clay (CC)	452025N	1064042W	006S041E	2	S2SW4
005	Rosebud	Canyon Creek	19 individuals occupying approx. 100 square yards. 95% fruiting, 5% vegetative.	Generally barren sandstone outcrops; calcium carbonate present; south-facing slope. Rocky Mountain juniper above, rabbit brush and silver sage on slope. Shrubs dominate: <i>Chrysothamnus nauseosus</i> , <i>Artemisia cana</i> , <i>Rhus trilobata</i> . Associated species: previously mentioned plus <i>Agropyron spicatum</i> .	Eastern Sedimentary Plains, 58AE	Badlands (BL)	451508N	1064256W	007S041E	9	NW4NE4

**Bolded** records indicate new occurrences documented during this survey.

## **Appendix 1**

**Pertinent Biological Information for *Astragalus barrii* and *Physaria didymocarpa* var. *lanata***

Information on *Astragalus barrii* has been largely taken from Heidel and Marriott (1996), unless otherwise noted. Information on *Physaria didymocarpa* var. *lanata* has been largely taken from the Montana Natural Heritage Program database, unless otherwise noted.

### ***Astragalus barrii* Barneby (Barr's milkvetch); Fabaceae**

#### **Species Description**

*A. barrii* forms dense mats (cushions), which rarely exceed 25.9 cm in height. Prostrate woody stems give rise to numerous leaves, each made up of narrowly elliptic leaflets that are 1-4 cm long. Both the stems and leaves of *A. barrii* are densely covered with short, white hairs. Iridescent bluish-purple to pinkish-purple flowers arise on short stalks (7-16 mm) throughout the mats on narrow, open, (1) 2-4 flowered inflorescences. The petals are 7-17 mm long. The calyx is 3-5 mm long and densely covered with long, white hairs. The sparsely white-hairy pod is narrowly elliptical, 4-8 mm long, and 1-2 mm wide. In Montana, this species blooms from late April to mid-June and later forms narrow, egg-shaped, one- to few-seeded pods. *A. barrii* may remain in a vegetative condition under stressful conditions.

#### **Key Identification Factors**

Flowers are necessary to distinguish *A. barrii* from similar *Astragalus* species. The species is distinctive for its small, iridescent, bluish-purple to bluish-pink, early-blooming flowers. Petal color may fade, sometimes to yellowish white, as flowers dry (Taylor pers. obs).

#### **Habitat**

This species occurs on heavy clay ("gumbo") knobs, badlands, buttes and barren hilltops, often on calcareous soft shale and siltstone substrates (Heidel & Marriott 1996). The calcareous clay soils on which *A. barrii* occurs are likely to be low in organic matter, as these locations are sparsely vegetated (Schassberger 1990). Habitats are characterized by a low vegetative cover, with *Pinus ponderosa* (ponderosa pine), *Juniperus scopulorum* (Rocky Mountain Juniper), *Artemisia tridentata* (sagebrush) and *Agropyron spicatum* (bluebunch wheatgrass) as common associates (Heidel & Marriott 1996). Elevation range is 3,140–4,160 f.a.s.l.

Populations of *A. barrii* are associated with the harsh edaphic and environmental conditions of Badlands areas. These areas receive limited rainfall and are subject to high light intensities, potentially limiting plant establishment and survival as a result of high soil water evaporation. This species often occurs on barren, eroded microsites and may depend on the climate that maintains these sites. At some locations, particularly steep slopes, the soils erode during intense rain storms. Because of its cushion habit and dense foliage, soil is protected from water erosion beneath *A. barrii* plants, resulting in individuals that are frequently perched atop small pedestals of soil (Heidel & Marriott 1996).

The species is found in Koppen's BSw climatic zone, a steppe climate east of the Continental Divide that is typified by cold, dry winters, and convective summer storms. In southeastern Montana, the regional climate is characterized by hot, dry summers. Spring rains bring the highest amount of precipitation, while summer storms are largely convective, delivering less precipitation. Winters are cold and dry, with precipitation occurring mostly in the form of snow (Schassberger 1990).

Major Land Resource Area (as defined by this study)  
Eastern Sedimentary Plains, 58AE

Ecological sites (as defined by this study):

Type: Rangeland; Site Names include Clayey (Cy), Shallow Clay (SwCy) and Badlands (BL).

#### Similar Species

Four other matt-forming, 3-leaflet *Astragalus* species overlap geographically with *A. barrii* in Montana. These are *A. aretioides* (cushion milkvetch), *A. sericoleucus* (silky milkvetch), *A. gilviflorus* (plains milkvetch) and *A. hyalinus* (summer milkvetch).

*A. aretioides* and *A. sericoleucus* have flowers that are typically one half the size of *A. barrii*, and tend to have denser mats. Both species are known from Big Horn County, but were not encountered during the survey.

*A. gilviflorus* and *A. hyalinus* typically have larger, cream to whitish flowers. They also differ from *A. barrii* by having a longer calyx tube (6-16 mm) and absent or shorter (<3.5 mm) peduncles (calyx length 2.8-5 mm, peduncle length 7-24 mm). Known in Montana from the Pryor Mountains and from the Ashland District of the Custer National Forest, *A. hyalinus* is similar in growth habit to *A. barrii* and is found in similar habitats.

The only similar looking *Astragalus* species observed during this survey was *A. gilviflorus* (see **Appendix 3.5**). This species is very abundant in the study area occurring in the same habitat and locations as *A. barrii*. The majority of *A. gilviflorus* plants were at the end of their blooming period. Vegetatively, *A. gilviflorus* appears more robust with longer leaf petioles and larger leaflets than *A. barrii*. The flowers, when present, are distinctly larger than those of *A. barrii*.

#### Present Legal or Other Formal Status

US Fish and Wildlife Service (USFWS): None. Previously a Category C3, signifying that the species has "proven to be more abundant or widespread than previously believed and/or...(is) not subject to any identifiable threat".

US Forest Service (USFS): Sensitive

BLM: Watch

MTNHP: G3 S3 (imperiled or vulnerable in the state). State ranking reasons: A regional endemic with 34 occurrences, occurring on fragmented and localized habitats on the landscape (Heidel & Vanderhorst 1999). With fewer than 100 occurrences, the species would typically be considered "imperiled" however almost half of its known occurrences are on national forest lands, where it is recognized as "sensitive", and where habitat threats are limited. Low-level potential threats exist from coal bed methane, mining and other development activities, as well as from grazing and herbicide application (Schassberger 1990; Heidel & Vanderhorst 1999; Taylor pers. obs.).

#### Distribution

A regional endemic of southwestern South Dakota, northeastern Wyoming and southeastern Montana. State Distribution is limited to southeastern Montana. Total number of state occurrences is 34, from Big Horn (2), Rosebud (12, includes 1 new occurrence from this survey), Powder River (19) and Carter (1) Counties.



***Physaria didymocarpa* var. *lanata* A. Nels. (wooly twinpod); Brassicaceae**

**Species Description**

Reprinted from Fertig (1992): *P. didymocarpa* var. *lanata* is a tufted, multi-stemmed perennial herb covered with long-stalked, tangled, multi-branched woolly hairs (giving the entire plant a gray appearance). Basal leaves are entire to coarsely dentate and shaggy-margined due to the long-stalked pubescence. Stem leaves are shorter, oblanceolate, and 1-2 cm long. The inflorescence consists of a congested cluster of yellow, 4-petaled flowers 8-12 mm long. Mature fruits consist of 2 inflated, balloon-like pods with shaggy pubescence. The replum of the mature fruit is narrowly lance-shaped to oblanceolate with 2 stubby funiculi (stalks connecting ovule to placenta) per face. Flowers from May-June, with fruits produced as late as September.

**Key Identification Factors**

Leaf pubescence (long, tangled, spreading hairs, especially at leaf bases) is sufficient for identification.

**Habitat**

Sandstone outcrops, redbed clay (clinker or scoria)-shale slopes, calcareous substrates, and road cuts; in open shrub-dominated slopes, sometimes with a sparse cover of ponderosa pine (*Pinus ponderosa*) and Rocky Mountain juniper (*Juniperus scopulorum*). Bluebunch wheatgrass (*Agropyron spicatum*) is a common associate. Elevation: 3300-4100 f.a.s.l.

**Major Land Resource Area (as defined by this study)**

Eastern Sedimentary Plains, 58AE

**Ecological sites (as defined by this study)**

Type: Rangeland; Site Names include Coarse Clay (CC) and Badlands (BL) and Thin Breaks (TB).

**Similar Species**

Many similar *Physaria* species exist in Montana. A microscope or hand lens, technical keys and reference to herbarium specimens are recommended for positive identification. *P. didymocarpa* var. *didymocarpa* (common twinpod) has appressed hairs on the basal leaves (giving them a smooth look), and there are mostly 3-6 ovules/funiculi per locule. *P. acutifolia* (sharp-leaf twinpod) also has leaves with appressed hairs. *P. brassicoides* (double twinpod) is most similar to *P. didymocarpa* var. *lanata*. In eastern Montana it occurs on clay hills and road cuts. It has appressed leaf hairs and a narrowly linear fruit partition whereas *P. didymocarpa* var. *lanata* has shaggy hairs and narrowly lanceolate to oblanceolate partitions. (Dorn 1992; Fertig 1992).

**Present Legal or Other Formal Status**

USFWS: None

USFS: None

BLM: None

MTNHP: G5T2 S1. State ranking reasons: A regional endemic which is known from 5 occurrences in the state, from East Big Horn and Rosebud counties. One of the populations in East Big Horn county numbers over one thousand individuals, however occurrences typically have low population densities (ranging from 16-100 individuals) and occupy fragmented and

localized habitats on the landscape. Low-level potential threats exist from coal bed methane, mining and other development activities, as well as from grazing and herbicide application (Schassberger 1990; Heidel & Vanderhorst 1999; Taylor pers. obs.). The species has only recently been documented in the state (first observation 1993), and requires the documentation of baseline information and monitoring.

#### Distribution

A Regional endemic of north-central Wyoming and adjacent Montana. Statewide distribution is limited to southeastern Montana. Total number of state occurrences is 5 (includes 4 new locations from this survey), from Big Horn (2) and Rosebud (3) Counties.

## Appendix 2

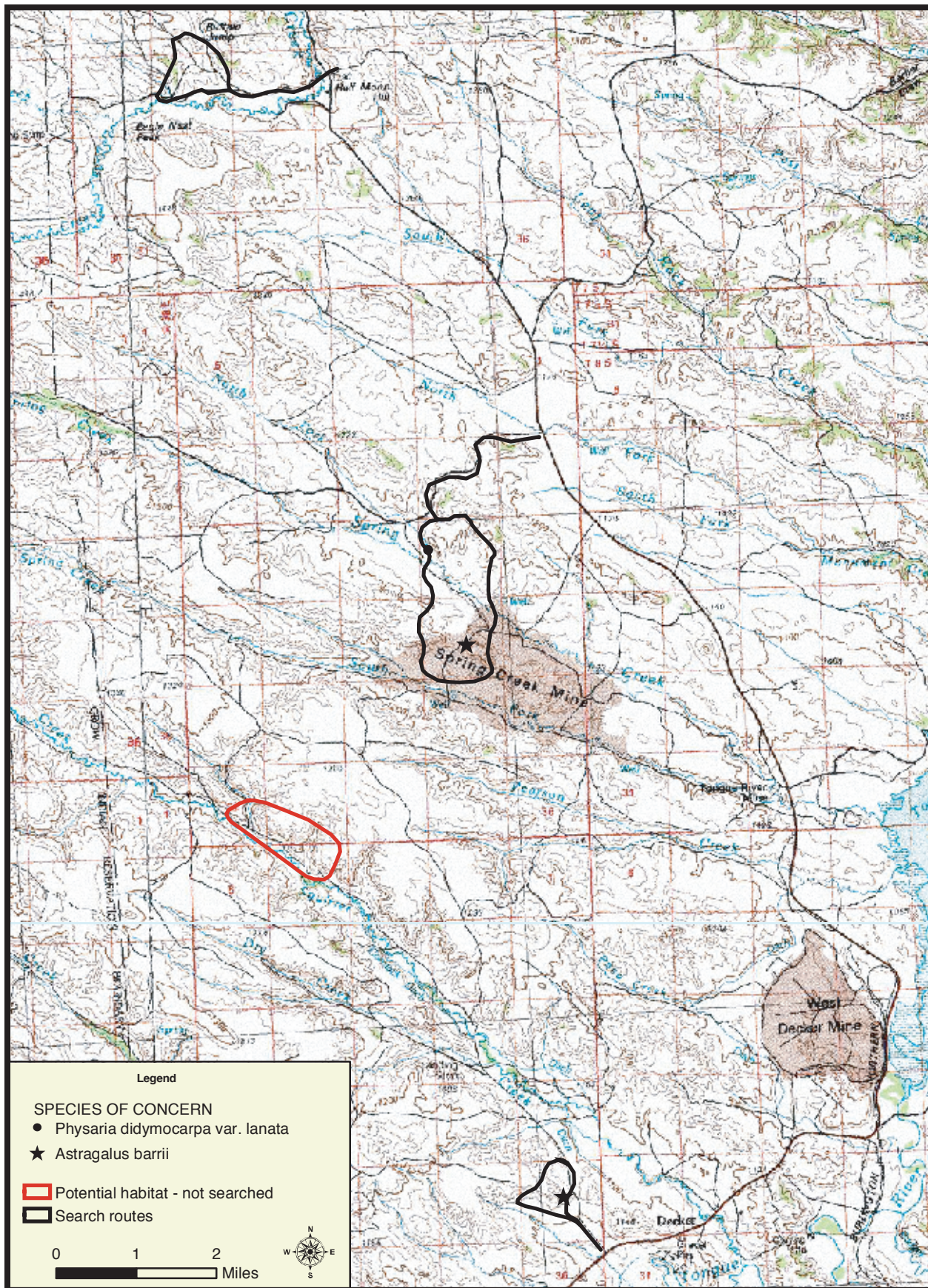
### Potential and Existing Habitat for *Astragalus barrii* and *Physaria didymocarpa* var. *lanata*

Solid black lines indicate search routes. Solid red lines represent potential habitat that was identified in the field but not surveyed because of access or time limits. *Astragalus barrii* locations are marked by black stars, whereas *Physaria didymocarpa* var. *lanata* locations are marked by black dots.

The 1:24,000 USGS Quad names and codes associated with each map are as follows:

	<i>Quad Name</i>	<i>Quad Code</i>
<u>Map 1:</u>	Half Moon Hill	4510628
	Pearl School	4510618
<u>Map 2:</u>	Spring Gulch	4510626
	Holmes Ranch	4510616
	Lacey Gulch	4510625
<u>Map 3:</u>	Stroud Creek	4510624
	Forks Ranch	4510614
	Quietus	4510613
<u>Map 4:</u>	Clubfoot Creek	4510645
	Birney	4510635
	Birney SW	4510636
	Spring Gulch	4510626
	Taintor Desert	4510637
	Tongue River Dam	4510627
<u>Map 5:</u>	Half Moon Hill	4510628
	Pearl School	4510618





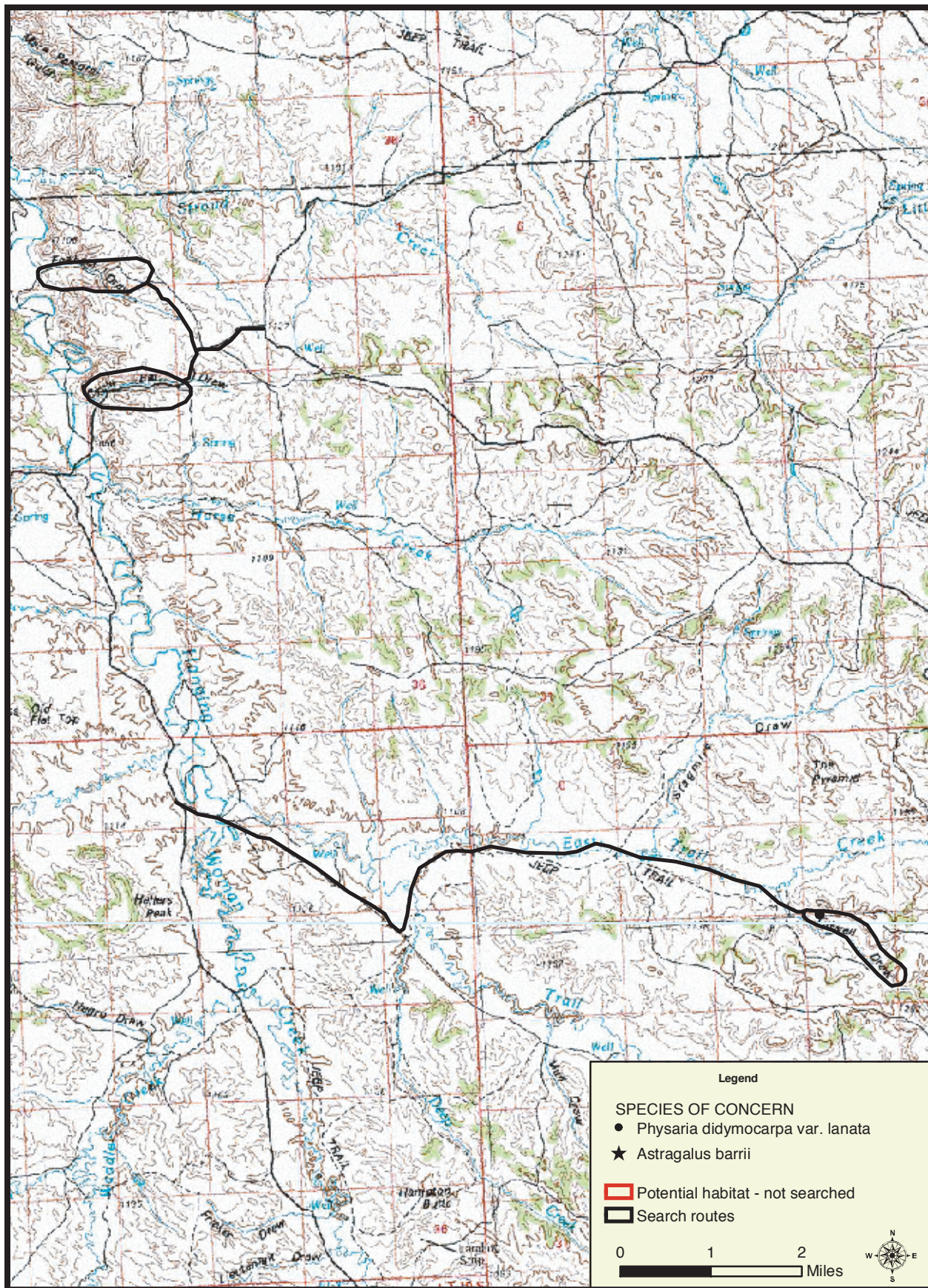
**Appendix 2.1.** Potential and existing habitat for *Astragalus barrii* and *Physaria didymocarpa* var. *lanata*. Solid black lines indicate search routes, whereas solid red lines represent potential habitat that was identified in the field but not surveyed because of access or time limits. *A. barrii* locations are marked by black stars, whereas *P. didymocarpa* var. *lanata* locations are marked by black dots. This 1:24,000 USGS Quad map is comprised of the Quads Half Moon Hill (4510628) and Pearl School (4510618).





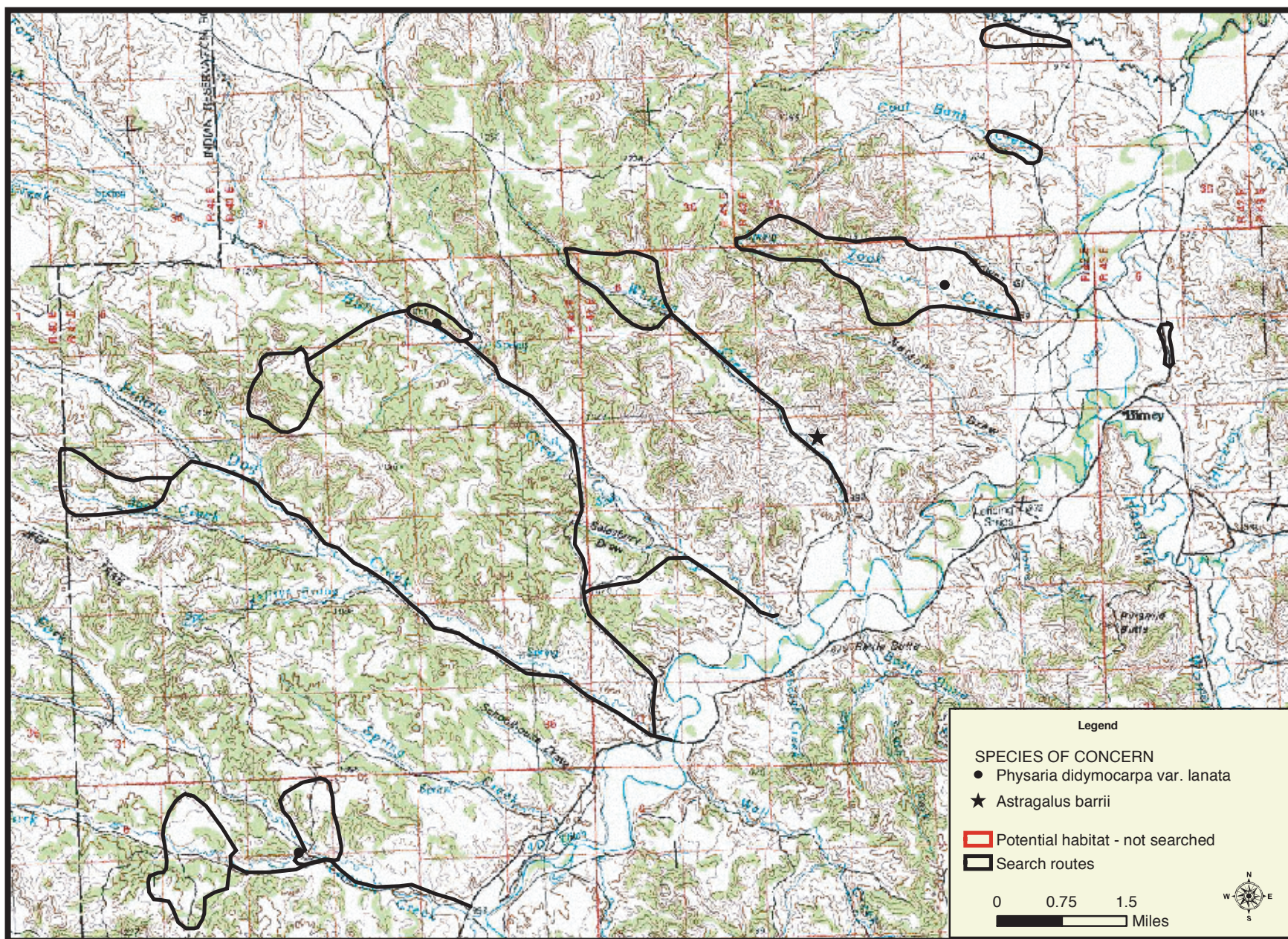
**Appendix 2.2.** Potential and existing habitat for *Astragalus barrii* and *Physaria didymocarpa* var. *lanata*. Solid black lines indicate search routes, whereas solid red lines represent potential habitat that was identified in the field but not surveyed because of access or time limits. *A. barrii* locations are marked by black stars, whereas *P. didymocarpa* var. *lanata* locations are marked by black dots. This 1:24,000 USGS Quad map is comprised of the Quads Spring Gulch (4510626), Holmes Ranch (4510616) and Lacey Gulch (4510625).





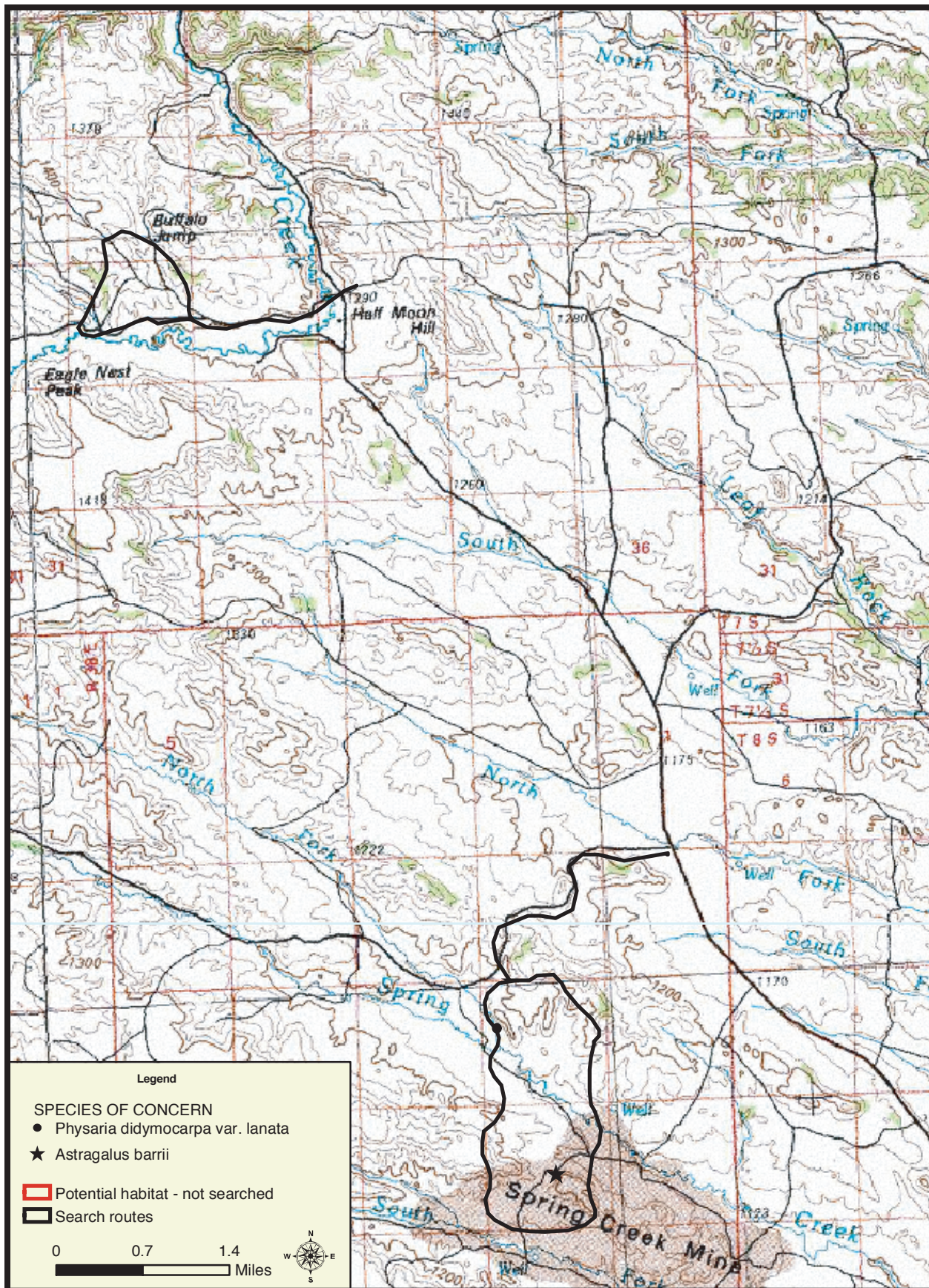
**Appendix 2.3.** Potential and existing habitat for *Astragalus barrii* and *Physaria didymocarpa* var. *lanata*. Solid black lines indicate search routes, whereas solid red lines represent potential habitat that was identified in the field but not surveyed because of access or time limits. *A. barrii* locations are marked by black stars, whereas *P. didymocarpa* var. *lanata* locations are marked by black dots. This 1:24,000 USGS Quad map is comprised of the Quads Stroud Creek (4510624), Forks Ranch (4510614) and Quietus (4510613).





**Appendix 2.4.** Potential and existing habitat for *Astragalus barrii* and *Physaria didymocarpa* var. *lanata*. Solid black lines indicate search routes, whereas solid red lines represent potential habitat that was identified in the field but not surveyed because of access or time limits. *A. barrii* locations are marked by black stars, whereas *P. didymocarpa* var. *lanata* locations are marked by black dots. This 1:24,000 USGS Quad map is comprised of the Quads Clubfoot Creek (4510645), Birney (4510635), Birney SW (4510636), Spring Gulch (4510626), Taintor Desert (4510637) and Tongue River Dam (4510627).





**Appendix 2.5.** Potential and existing habitat for *Astragalus barrii* and *Physaria didymocarpa* var. *lanata*. Solid black lines indicate search routes, whereas solid red lines represent potential habitat that was identified in the field but not surveyed because of access or time limits. *A. barrii* locations are marked by black stars, whereas *P. didymocarpa* var. *lanata* locations are marked by black dots. This 1:24,000 USGS Quad map is comprised of the Quads Half Moon Hill (4510628) and Pearl School (4510618).



## **Appendix 3**

### **Selected Plant and Habitat Photographs**



**Appendix 3.1.** *Physaria didymocarpa* var. *lanata* (wooly twinpod) with inflated fruits. Photo taken June 19, 2001, T6S R41E S2, Bull Creek, Rosebud County, Montana.



**Appendix 3.2.** *Physaria didymocarpa* var. *lanata* (wooly twinpod) basal rosette and fruits. Photo taken June 20, 2001, T6S R42E S2, Zook Creek, Rosebud County, Montana.



**Appendix 3.3.** *Physaria didymocarpa* var. *lanata* (wooly twinpod) habitat. Photo taken June 19, 2001, T6S R41E S2, Bull Creek, Rosebud County, Montana.





**Appendix 3.4.** *Astragalus barrii* (Barrís milkvetch) habitat. Photo taken June 22, 2001, T6S R42E S16, Whitten Creek, Rosebud County, Montana.



**Appendix 3.5.** *Astragalus gilviflorus* (plains milkvetch), a species common in the study area and similar in appearance to *A. barrii*. Photo taken June 20, 2001.